

I claim:

1. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:
5 reducing said polarization mode dispersion using a cascade of all-pass filters; and
adjusting coefficients of said all-pass filters using a least mean square algorithm.
- 10 2. The method of claim 1, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
3. The method of claim 1, wherein said coefficient values are adjusted to
15 minimize a cost function.
4. The method of claim 1, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
- 20 5. The method of claim 4, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

6. The method of claim 1, wherein said least mean square algorithm adjusts said coefficients as follows:

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$$w(n+1) = w(n) - \mu \nabla(J),$$

where w is a composite coefficient vector defined as:

$$w = \begin{bmatrix} a \\ b \end{bmatrix}, \quad \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial a^T} & \frac{\partial J}{\partial b^T} \end{bmatrix}^T$$

is the $(P+Q) \times 1$ complex gradient of J with respect to w , and

$$\frac{\partial J}{\partial a^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \dots & \frac{\partial J}{\partial a_P} \end{bmatrix}, \text{ and}$$

$$\frac{\partial J}{\partial \mathbf{b}^T} \equiv \left[\frac{\partial J}{\partial b_1} \quad \frac{\partial J}{\partial b_2} \quad \dots \quad \frac{\partial J}{\partial b_Q} \right].$$

7. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:
- 5 reducing said polarization mode dispersion using a cascade of all-pass filters; and
- adjusting coefficients of said all-pass filters using a Newton algorithm.
8. The method of claim 7, wherein said cascade of all-pass filters comprises a
- 10 two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
9. The method of claim 7, wherein said coefficient values are adjusted to minimize a cost function.
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10. The method of claim 7, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
11. The method of claim 10, wherein said measuring step employs a tunable
- 20 narrowband optical filter to render information from energy detector measurements.
12. The method of claim 7, wherein said Newton algorithm adjusts said coefficients as follows:

$$\mathbf{w}(n+1) = \mathbf{w}(n) - \mu \mathbf{H}^{-1} \nabla(J)$$

- 25 where \mathbf{w} is a composite coefficient vector defined as:

$$\mathbf{w} = \begin{bmatrix} \mathbf{a} \\ \mathbf{b} \end{bmatrix}, \quad \nabla(J) \equiv \left[\frac{\partial J}{\partial \mathbf{a}^T} \quad \frac{\partial J}{\partial \mathbf{b}^T} \right]^T$$

$$\frac{\partial J}{\partial \mathbf{a}^T} \equiv \left[\frac{\partial J}{\partial a_1} \quad \frac{\partial J}{\partial a_2} \quad \dots \quad \frac{\partial J}{\partial a_P} \right], \text{ is the } (P+Q) \times 1 \text{ complex gradient of } J \text{ with respect to } \mathbf{w},$$

a Hessian matrix, \mathbf{H} , is defined as follows:

$$H = \frac{\partial^2 J}{\partial \mathbf{w} \partial \mathbf{w}^T} = \begin{bmatrix} \frac{\partial^2 J}{\partial \mathbf{a} \partial \mathbf{a}^T} & \frac{\partial^2 J}{\partial \mathbf{a} \partial \mathbf{b}^T} \\ \frac{\partial^2 J}{\partial \mathbf{b} \partial \mathbf{a}^T} & \frac{\partial^2 J}{\partial \mathbf{b} \partial \mathbf{b}^T} \end{bmatrix} \text{ and}$$

$$\frac{\partial J}{\partial \mathbf{b}^T} \equiv \left[\frac{\partial J}{\partial b_1} \quad \frac{\partial J}{\partial b_2} \quad \dots \quad \frac{\partial J}{\partial b_Q} \right].$$

13. A polarization mode dispersion compensator in an optical fiber
5 communication system, comprising:
a cascade of all-pass filters having coefficients that are adjusted using a
least mean square algorithm.

14. The polarization mode dispersion compensator of claim 13, wherein said
10 cascade of all-pass filters comprises a two-channel structure consisting of multiple
cascades of all-pass filters and directional couplers.

15. The polarization mode dispersion compensator of claim 13, wherein said
coefficient values are adjusted to minimize a cost function.

16. The polarization mode dispersion compensator of claim 13, further
comprising the step of measuring said polarization mode dispersion in a received optical
signal.

20 17. The polarization mode dispersion compensator of claim 16, wherein said
measuring step employs a tunable narrowband optical filter to render information from
energy detector measurements.

18. A polarization mode dispersion compensator in an optical fiber
25 communication system, comprising:
a cascade of all-pass filters having coefficients that are adjusted using a
Newton algorithm.

19. The polarization mode dispersion compensator of claim 18, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

5 20. The polarization mode dispersion compensator of claim 18, wherein said coefficient values are adjusted to minimize a cost function.

21. The polarization mode dispersion compensator of claim 18, further comprising the step of measuring said polarization mode dispersion in a received optical
10 signal.

22. The polarization mode dispersion compensator of claim 21, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

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